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Factors That Influence Rural and Rural Farm Income in Minnesota

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CONTENTS

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SUMMARY

Factors that influence the welfare of rural and rural farm residents concern state and federal policymakers who strive to improve welfare for these groups. As measured by income levels, welfare is influenced by a number of factors that can be identified and changed through various remedial programs. This study was undertaken to identify the factors that contributed to rural farm income levels in Minnesota laborsheds in 1949 and 1959 and to rural income levels in 1959.

The unit investigated was defined as a laborshed, the area in which most of a county's residents were employed. Minnesota counties in most instances were distinct laborsheds, but some counties were grouped. Some 22 variables were constructed and examined by means of simple correlations. From this group, 11 variables were selected for study by multiple regression analysis.

Variables selected represented population and labor force characteristics, the changing structure of industry, farm size, capital availability in laborsheds, degree of local urbanization as well as the proximity of laborsheds to urban-industrial concentrations, and natural resource endowments.

In 1949, rural farm income in Minnesota laborsheds was determined largely by factors related to local agriculture (farm size and agricultural resource endowment) and by the age and education of the rural farm population. Minerals and forest resources probably affected rural farm income only in the five or six laborsheds in which mining and forestry were important. The changing structure of industry in Minnesota laborsheds, local urbanization, and proximity to large industrial-urban concentrations played minor roles, if any at all.

By 1959, a number of important changes had occurred. While farm size and agricultural resources still played important roles in determining rural farm income, population characteristics ceased to be important. And the combined influences of urbanization and proximity to large metropolitan areas became more important. Net migration from rural to urban laborsheds was not sufficient to erase the positive relationship between rural farm income and urbanization. Rural income levels in 1959 were influenced by urbanization, industrialization, and proximity to large industrial-urban concentrations. The presence of natural resources, the prevalence of rural adults with at least high school educations, the prevalence of elderly rural adults, and farm size also were important. Inadequate measures of capital availability and mineral and forest resources precluded a clear judgment of their effect on rural income. Finally, urbanization and industrialization appear to have spread out from existing metropolitan centers since 1940, rather than to have developed either randomly or uniformly throughout the state.

Factors That Influence Rural and Rural Farm Income in Minnesota

ANNE ELIZABETH HAMMILL and W. KEITH BRYANT

The incomes of U.S. rural and rural farm residents differ among states and among counties. Associated with income disparities are wide differences in well-being as indicated by diverse living level indexes. Although many rural and rural farm incomes are high enough to allow families to live in a style commensurate with comparable urban families, rural poverty is widespread.

Minnesota has prosperous as well as submarginal farmers and high as well as low income rural residents. Wide ranges of temperature and rainfall as well as differences in soil quality and resource endowments exist in the state. Because Minnesota is a microcosm of physical attributes and human characteristics associated with income levels, it is a desirable laboratory for research relating to income differences.

In recent years, the entire rural community has received attention from researchers and policymakers in the U.S. Department of Agriculture (USDA), at universities, and elsewhere. Efforts to identify growth centers, to facilitate rural area development, and to examine the feasibility of rural residents remaining in rural areas have been undertaken. But before efficient development of rural areas can take place, the factors that contribute to growth and income must be identified. Once this is done, programs can be instituted to improve low incomes and increase those already at satisfactory levels.

The research reported here was initiated by the University of Minnesota in cooperation with the Economic Research Service, USDA. The objective was to identify the influences on median family rural and rural farm incomes in Minnesota exerted by the following variables: population and labor force characteristics, the changing structure of industry, farm size, capital availability in laborsheds, degree of urbanization as well as the proximity of laborsheds to urban-industrial concentrations, and natural resource endowments.

PREVIOUS RESEARCH

The study of variables associated with natural resource endowments and industrial-urban development builds upon research conducted along similar lines. According to previous work (2, 3, 4, 15), Minnesota is located in a transition zone. East of the Mississippi River, rural farm and rural nonfarm income as well as the earnings of farmers and farm managers per county are higher the closer a county is to a metropolitan concentration and the larger the concentration. The same relationship between proximity to industrial-urban concentration and rural income exists along

the Pacific coast. But in the region between, no such relationship has been observed. Consequently, a specific study of the effects of proximity on rural and rural farm income in a state bordering the eastern region may shed additional light on the industrial-urban development hypothesis (14).

Previous studies testing the industrial-urban development hypothesis have emphasized one of three dimensions: industrialization (11, 17), urbanization (13, 15), or location (2, 3, 4). This study attempted to determine the individual effects of all three dimensions on rural farm income.

Because the boundaries of laborsheds need not, and often do not, coincide with county boundaries, an attempt was made to use areas encompassing local labor markets as observation units. Local labor markets were found to be important in previous work (3, 4, 13, 11). Work done by Fox (5) suggested that the county is not an adequate unit of observation.

The industrial-urban development hypothesis as postulated by Schultz (14) argued that differentials in land quality were not important in explaining locational differences in farm income or growth rates of farm income. Nicholls (11) and Tang (17) found natural resource endowments to be important only before 1900 in the Southeastern areas they studied. Agriculture, forestry, and mining are three important industries in rural Minnesota. This study attempted to measure the impact on rural and rural farm income of these three natural resource based industries and the impact of the resource endowments on which they rely.

CHARACTERISTICS OF MINNESOTA

Minnesota has 87 counties and three standard metropolitan statistical areas (SMSA's): the Twin Cities metropolitan area (TCMA), which includes Minneapolis and St. Paul; Duluth, Minnesota-Superior, Wisconsin; and Fargo, North Dakota-Moorhead, Minnesota.

Most Minnesota counties are self-contained units in terms of employment; that is, most of the people who live in a county work in the same county. However, where a major city offers job opportunities, several counties may form a single laborshed. This situation also occurs where border cities form a laborshed across state lines. Data for this research were suitably aggregated so that a single figure represented each laborshed of combined counties.

Types of farming vary throughout the state. Farms in the southwestern counties raise corn and soybeans and do some livestock feeding. In the central and southeastern counties, dairying is important. The northwestern counties in the Red River Valley are devoted to small grains and potatoes grown as cash crops. In the northeast, farming is mixed.

Forestry and mining exist primarily in the northeast and offer opportunities for off-farm employment. The SMSA's also offer off-farm employment opportunities, as do major secondary and tertiary cities, which are located principally in the southeastern and south central parts of the state.

Incomes also differ throughout Minnesota. Median family and unrelated individual incomes for rural farm residents in 1950 fell almost entirely into

two groups: those below $2,000 (northern half of the state) and those above $2,000 (southern half of the state).

By 1960, rural farm median family and unrelated individual incomes had increased. The highest incomes ($4,000-$4,999) occurred in the TCMA and counties near SMSA's. Off-farm job opportunities were greatest near areas of high income.

Patterns for 1960 rural median family and unrelated individual incomes were similar to 1960 rural farm income patterns, but were higher in the TCMA and certain other counties.

HYPOTHESES

Several factors generally are considered important in explaining why rural farm income in one laborshed is different from that in another. These factors are: characteristics of the population and the labor force; structure of local industry, including agriculture; location of the laborshed relative to urban concentrations; availability of capital; and natural resource endowments.

POPULATION AND LABOR FORCE

Four interrelated factors were used to characterize the population and the labor force: age, formal education, the unemployment rate, and net migration.

The age distribution of the population determines its dependency and, to a certain extent, its physical productivity. The young either are not employed or earn low incomes because of lack of education, experience, or seniority. Old persons are retired or, because of lack of education and reduced physical capacity, earn low incomes. So the greater the proportion of young and old persons in the population, the lower the rural or rural farm income level is likely to be.

Two age variables were specified in the analysis: the percentage of the rural or rural farm population younger than 25 years and the percentage 45 years old and older.

Education was measured in terms of human capital accumulated by formal schooling among those over 25 in the rural or rural farm population. Two education variables were specified: the percentage of the rural or rural farm population that had completed fewer than 7 years of school and the percentage that had completed at least high school. The former variable is a proxy for the proportion of functional illiterates; the latter is a proxy for the proportion of highly educated persons. The lower the former and the higher the latter proportion, the higher the income level in a laborshed is likely to be.

Net migration per laborshed from 1950 to 1960 was studied with respect to 1960 income levels. The net migration rate summarizes a multitude of economic and sociological forces, all of which are not clearly understood. Net outmigration may represent a lack of available jobs and underemployment in a laborshed, combined with an excess supply of

jobs elsewhere. The question in this study was whether net outmigration during the fifties was sufficient to eliminate the excess labor in rural laborsheds. If outmigration during the fifties was sufficient to drain off the excess labor in a laborshed over the period, income levels of the remaining population would be higher than before. However, since migrants tend to be young adults, the dependency ratio of the residual population may be higher, counteracting the positive effects of migration on income.

In an attempt to hold the current condition of the labor market in Minnesota laborsheds constant, the unemployment rate published in the 1960 Census of Population was used. This rate measures unemployment for 1 week in the spring the census was taken. It was assumed to be representative of average conditions in respective census years.

STRUCTURE OF LOCAL INDUSTRY

The industrial-urban development hypothesis argues that growth does not take place uniformly in space or time. Moreover, the hypothesis states that, where growth occurs, it is essentially of an industrial-urban character, and rural income levels are higher than where growth does not occur. This development is partially so because industrial-urban growth shifts the labor demand to the right in the nonfarm sector, provides full- and part-time nonfarm employment for farm labor, and raises real wages. By providing off-farm job opportunities, industrial-urban growth facilitates increases in farm size and efficiency and hence higher farm income. Therefore, the relative changes in employment by industry from 1940 to 1950 and from 1950 to 1960 were included as variables.[1] Relative change variables were specified for the following sectors: agriculture; forestry and fisheries; mining; manufacturing; transportation and communications; wholesale and retail trade; and finance, insurance, real estate, and services.

Average farm size in acres for each laborshed also was specified as a variable: The larger the farm size, the higher rural or rural farm income was expected to be.

LOCATION AND URBANIZATION

Two facets of location and urbanization were expected to influence rural farm and rural income levels. First, the closer the metropolitan areas and the more numerous and populated they were, the higher rural or rural farm income was expected to be. Second, rural or rural farm income in a laborshed was expected to depend on the extent of urbanization in the laborshed itself.

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[1] The relative change in employment in an industry sector for a county (12, p. 71) may be expressed as:
$S_t = E^*_{ij} - (E^*../E..)\, E_{ij}$
where
S_t = relative change
E^*_{ij} = employment in $_i$th industry in $_j$th county in terminal year
$E^*..$ = total national employment in all industries
$E..$ = total national employment in all industries in initial year
E_{ij} = employment in $_i$th industry in $_j$th county in initial year

Three variables were specified as proxy variables in measuring these influences. The proxy variable used to measure the location of laborsheds relative to metropolitan areas and the size of the metropolitan areas was the population/distance variable.[2] The specification of this variable assumed that SMSA's were metropolitan areas; i.e., industrial-urban concentrations. Specification also assumed that no SMSA farther than 200 miles from a laborshed had any influence on rural or rural farm income in that laborshed.

The extent of urbanization in a laborshed was measured by two alternative proxy variables: the percentage of the total laborshed population that was urban and a zero-one dummy variable that indicated the presence or absence of urban centers equal to or greater than "complete shopping centers" [see (1) for a specification of these towns and cities]. Thirty-seven laborsheds in Minnesota contain cities and towns of the complete shopping center class or larger (figure 1).

AVAILABILITY OF CAPITAL

An important reason for the lack of growth in a laborshed may be that profitable investment opportunities are not exploited because of the unavailability of risk capital. The lack of such capital may be partially explained by the inefficiency of rural and small town banks in financing local investment.

Data on capital availability are difficult to obtain and no satisfactory measure was obtained. In lieu of a better measure, the ratio of bank loans and discounts to bank deposits was used.[3] If the ratio in a laborshed is high, local banks are loaned to their limit and additional capital is unavailable relative to other laborsheds where ratios are low.

NATURAL RESOURCE ENDOWMENTS

To test the relationship between rural and rural farm income levels in laborsheds and natural resource endowments, three variables were specified: an index of crop production value, a forestry value index, and an index indicating the presence or absence of principal mineral deposits.

The index of crop production value was devised to represent differences in soil productivity throughout the state. The index was constructed in the following manner. Crop acres, yields, and prices were obtained for

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[2] The population/distance variable may be expressed as:

$$X_i = \Sigma_j (P_j/d_{ij})$$

where

P_j = the population of the jth SMSA

d_{ij} = distance from the center of laborshed i to the jth SMSA ($1 \leq d_{ij} \leq 200$ miles)

X_i = index of proximity of laborshed i to metropolitan areas within a radius of 200 miles [See (6, pp. 533-44) for variants of this index. See (19, p. x) for a description of SMSA's.]

[3] Data on each bank in the study area for 1950 and 1960 were provided by the Federal Reserve Bank of Minneapolis. These data were aggregated into a ratio for each laborshed for each of the 2 years.

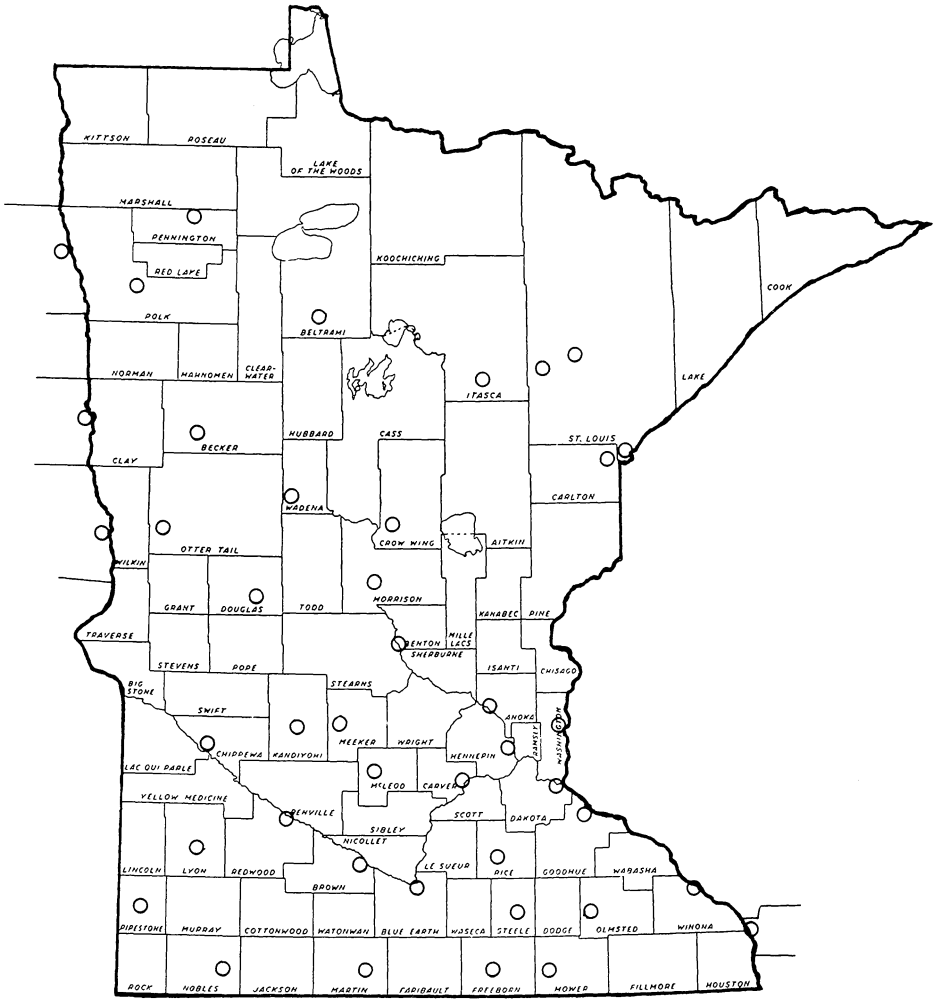

Figure 1. Urban centers equal to or larger than a complete shopping center.

1949 and 1959.[4] Values for each crop were added together and divided by total crop acres to give the average value of cropland per acre per laborshed. Although production costs probably do differ among Minnesota counties, no effort was made to include costs explicitly. It was assumed that farmers exercise their knowledge of cost-price relationships when they choose cropping patterns. Hence the crops actually produced were assumed to represent optimum profit conditions for a given laborshed. Unusual weather was recognized as a possible hazard in calculating crop indexes; i.e., if weather conditions were abnormal, differences in value per acre could be attributed to climate rather than to soil productivity. Weather conditions in both years were studied and the conclusion was that approxi-

[4] Source of data was (8).

mately normal crop yields were experienced, even though weather conditions in both periods were not typical.

The crop value index included implicit allowances for differences in management practices, temperature and moisture conditions that influence yields, conservation improvements that increase yields, and government programs that influence the amounts and kinds of crops grown. It did not include adjustments for direct payments under government programs that compensate for idle land or affect crop prices. However, this kind of farm program was not in effect in 1949. In 1959, the acres in soil bank conservation reserve in Minnesota amounted to 5.73 percent of all farmland acreage.

The forestry value index was constructed to represent the contribution of forestry to the resource base of a given laborshed. The following procedure was used in constructing it.[5] The growing stock of hard- and softwoods was recorded for each laborshed.[6] Those laborsheds with more than 25,000,000 cubic feet of growing stock were selected as important counties for forestry. Cubic feet of growing stock for each county were separated according to hard- and softwood. Prices for all softwoods were assumed to be the same as jack pine prices, and aspen prices were used for all hardwoods. Prices for pulpwood at each of the districts in Minnesota for 1959 were used in computing the value index.[7] The index computed represents the value in 1959 of harvestable timber whether or not it actually was cut.

Prices for timber in 1949 were not available. Because it would have been extremely hazardous to derive prices according to some hypothesized percentage increase or decrease from 1949 to 1959 and because 1949 figures on growing stock may be erroneous due to poor reporting or poor estimating techniques, the 1959 value index also was used for the 1949 equation.

Iron ore represents the principal known mineral deposit in Minnesota. Iron ore mines are located in several laborsheds. Because mining is an activity that depletes the resource, measuring or evaluating its contribution to an area is difficult. Perhaps past contributions to the area's wealth have been greatest and should be valued higher than present or future contributions. Because of this measurement problem, a zero-one variable was used. Those laborsheds in which iron mines exist (St. Louis, Crow Wing, Itasca, and Fillmore Counties) were designated by one; all other laborsheds were designated by zero.

DEPENDENT VARIABLE

Rural income levels in laborsheds were measured by two variables: the median income of rural families and unrelated individuals and the median income of rural farm families and unrelated individuals. Rural refers to

[5] On the advice of Richard A. Skok, Professor, School of Forestry, University of Minnesota, St. Paul, Minnesota.
[6] Obtained from (11, table 31).
[7] Source for the prices was (9).

those residents who were classified as rural in the 1960 Census of Population. Rural farm refers to those residents classified as rural farm in the 1950 and 1960 Censuses of Population. The median income of rural or rural farm families and unrelated individuals in a laborshed served as a proxy for the respective income levels in the laborshed.

UNIT OF OBSERVATION

The observation unit in this study was the local labor market or laborshed; i.e., the area in which most of the residents worked. For most of Minnesota the county comprises the laborshed. Investigation of the PH-4 tables from the 1960 Census of Population, however, revealed that more than 15 percent of the employed residents of some counties worked in other counties in 1960. In these cases the counties were grouped into multi-county laborsheds. The laborsheds that contained two or more counties were:

1. The TCMA with 10 counties: Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Washington, and Wright.
2. The St. Cloud laborshed of Benton, Sherburne, and Stearns Counties.
3. The Rochester laborshed of Dodge and Olmstead Counties.
4. The Mankato laborshed of Nicollet and Blue Earth Counties.
5. The border cities of Grand Forks that make up the laborshed including Polk County, Minnesota, and Grand Forks County, North Dakota.
6. The Fargo-Moorhead border cities that encompass Clay County, Minnesota, and Cass County, North Dakota.
7. The city of La Crosse, which includes in its laborshed Houston County, Minnesota, and La Crosse County, Wisconsin.

Data for the variables specified above were aggregated from county data. The laborsheds are shown in figure 2.

ANALYSES

Three separate regression analyses were conducted. The dependent variables were: median income in 1949 of rural farm families and unrelated individuals, median income in 1959 of rural farm families and unrelated individuals, and median income in 1959 of rural families and unrelated individuals.

SELECTION OF VARIABLES

The matrices of simple correlations among all the variables were used in selecting the variables for inclusion in the analyses. A common set of variables was desired to facilitate intertemporal comparisons as well as comparisons between the rural farm and total rural populations. Appendix A contains the matrices of simple correlation coefficients.

The bank loans to deposits ratio was chosen because it was the only measure of credit available. No other variable was closely related to it.

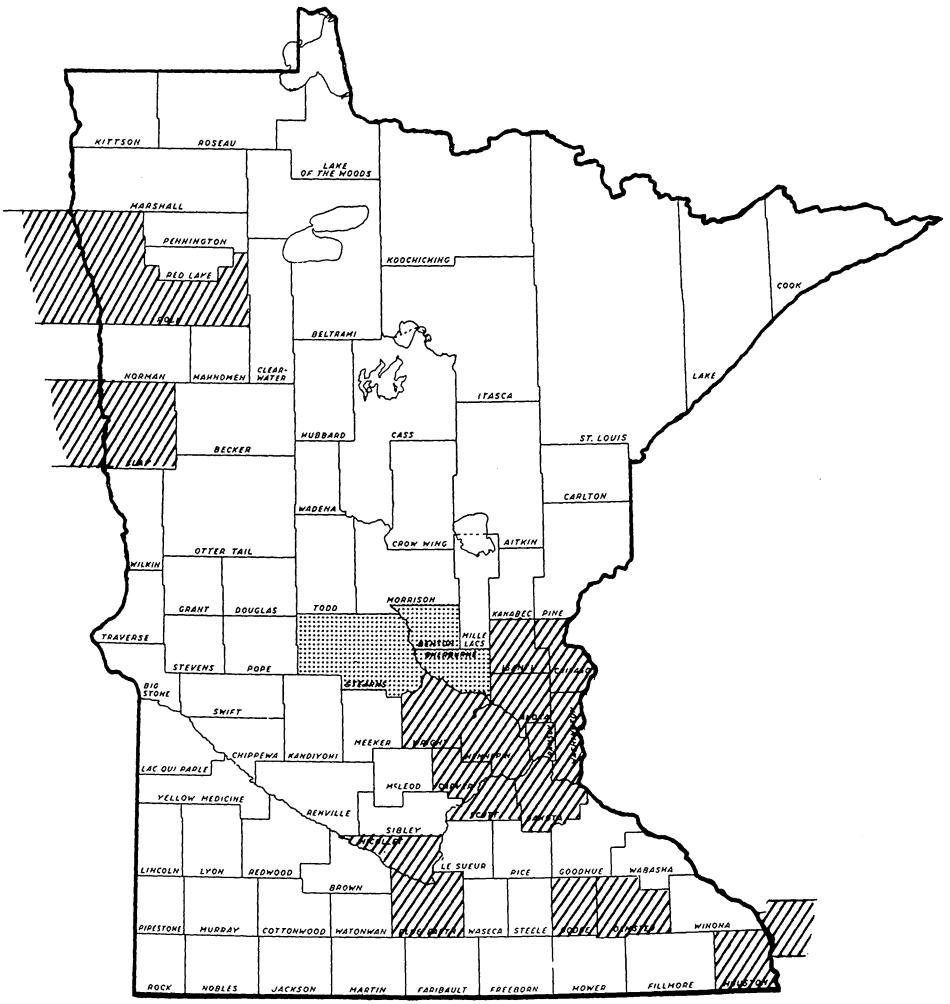

Figure 2. Units of investigation.

The percentage urban variable was chosen over the complete shopping center variable to represent urbanization. The two variables were reasonably correlated in the two time periods (.65 in 1950 and .73 in 1960), and neither was highly correlated with the population/distance variable, which represented the proximity to large urban-industrial concentrations.

In general, all of the relative change variables were closely related to one another. Also, all were closely related to the population/distance variable. The relative change in manufacturing employment was used to represent changes in the industry structure of employment in the previous 10 years and the proximity of the laborshed to large industrial-urban concentrations.

The proportion of the rural farm (rural) population age 45 and over was included to capture the effects of differing age distributions among laborsheds. This variable was correlated with the percentage under 25 years old. Hence, it provided a rough measure of the relative prevalence in a laborshed of both the young and the old.

The education or formal schooling variables were used in separate equations. Since each measured different facets of the education distribution, both were retained. Only for the rural farm population in 1949 were the education variables highly correlated with proximity to large industrial-urban concentrations. Both variables also were closely correlated with relative changes in employment by industry in 1949.

Scatter diagrams were constructed in the crop value index-income level plane for each dependent variable. There appeared to be two separate laborshed populations in the 1960 diagrams: high income level-low crop value index laborsheds and all other laborsheds. The laborsheds in the high income level-low crop index population differed slightly from the rural farm and rural analyses. Consequently, the crop value index variable was split into two variables for each of the 1959 analyses.

Table 1. Results of analysis of rural farm income in Minnesota laborsheds, 1949 and 1959

	1949 income, rural farm family		1959 income, rural farm family	
R^2	.6701	.6778	.7523	.7217
Independent variables	I	II	III	IV
Bank loans and discounts/deposits	−.02478	−.02631	.04932	.03176
	(.06644)	(.06574)	(.06831)	(.07278)
Percentage urban	.00018	.00026	.00018	.00019
	(.00020)	(.00019)	(.00024)	(.00026)
Average farm size	.00021*	.00018*	.00018*	.00017*
	(.00008)	(.00008)	(.00006)	(.00006)
Age, 45 years and over	−.00547*	−.00562*	−.00047	.00085
	(.00175)	(.00173)	(.00115)	(.00114)
Education, 0-6 years	−.00189*	.....	.00414*	.....
	(.00092)	.....	(.00150)	.....
Education, 12 years and more	.....	.00270*	.....	.00016
	.....	(.00113)	.....	(.00078)
Crop index	.00370*	.00387*	.....	.....
	(.00082)	(.00073)	.....	.....
Crop index I	.....	.....	.00603*	.00633*
	.....	.....	(.00084)	(.00089)
Crop index II	.....	.....	.00241*	.00223*
	.....	.....	(.00044)	(.00048)
Zero-one mines	279.55391	291.34679	185.10022	129.12966
	(164.00307)	(162.12429)	(179.13652)	(191.28848)
Relative change in manufacturing	.04855*	−.05479	.02213	.02418
	(.02110)	(.03108)	(.01304)	(.01387)
Net migration	.....	.....	.00194	.00154
	.....	.....	(.00104)	(.00110)

* Significantly different from zero at the .05 level of significance.

Table 2. Results of analysis of rural income levels in Minnesota laborsheds, 1959

Independent variables	1959 income, rural family	
R^2	.6910	.7464
	V	VI
Bank loans and discounts/deposits	−.06846	.14126
	(.08661)	(.08055)
Percentage urban	−.00047	−.00031
	(.00032)	(.00029)
Average farm size	.00019*	.00013
	(.00008)	(.00007)
Age, 45 years and over	−.00223	−.00314
	(.00175)	(.00161)
Education, 0-6 years	−.00003	.....
	(.00050)	.....
Education, 12 years and over	.....	.00387*
	.....	(.00104)
Crop index III	.00484*	.00480*
	(.00097)	(.00088)
Crop index IV	.00184*	.00164*
	(.00052)	(.00048)
Zero-one mines	60.38226	−100.11490
	(237.52633)	(219.44379)
Relative change in manufacturing	.03524*	.03225*
	(.01747)	(.01585)
Net migration	.00495*	.00374*
	(.00083)	(.00082)

* Significantly different from zero at the .05 level of significance.

In the 1959 rural farm equations the crop index variables were specified as:

X_{Ii} = crop value index of laborshed i if i = Clay-Cass, Carlton, Polk-Grand Forks, St. Louis, Red Lake, Itasca, Koochiching, Crow Wing, or Mille Lacs laborshed

= 0, otherwise

X_{IIIi} = crop value index of laborshed i if $X_{Ii} = O$

= 0 if $X_{Ii} > 0$

In the 1959 rural equations the crop index variables were specified as:

X_{IIIi} = crop value index of laborshed i if i = Clay-Cass, Carlton, Polk-Grand Forks, St. Louis, Itasca, Koochiching, Crow Wing, Benton-Sherburne-Stearns, Cook, or Lake laborshed

= 0, otherwise

X_{IVi} = crop value index of laborshed i if $X_{IIIi} = 0$

= 0 if $X_{IIIi} > 0$

The zero-one mining variable was included to take account of those laborsheds in which iron ore deposits were important. Since it also was correlated with the forestry value index and the unemployment rate, these variables were not included in the final equations.

Net migration from 1950 to 1960 was included in the equations for 1959 (rural farm and rural). Data on net migration from 1940 to 1950 were unavailable. Net migration from 1950 to 1960 was closely related to local urbanization, average farm size, and relative change in agricultural employment.

REGRESSION RESULTS

The final results of the regression analyses are shown in tables 1 and 2. Two equations are shown for each dependent variable. In the first, the percentage with less than 7 years of education variable was used; in the second, the percentage with 12 or more years of education variable was used.

RURAL FARM: RESULTS AND INTERPRETATION

Population and labor force characteristics were represented by the age and education variables in 1949 and by the age, education, and migration variables in 1959. The results of these variables were quite different for the two time periods. Age and education were important factors affecting rural farm income in 1949. The more prevalent rural farm people age 45 and over were and the higher the proportion of rural farm adults with less than 7 years of schooling was, the lower was rural farm income. And, the more prevalent rural farm adults with at least a high school education were, the higher was rural farm income. These relationships were not true in 1959.

By 1959, age and education had become less important as determinants of rural farm income. Between 1949 and 1959 the following changes had taken place in simple correlations between income and other variables.

Simple Correlations

Rural farm income	*1949*	*1959*
vs. education, 0-6 years	—.39	.14
vs. education, 12 years or more	.26	.13
vs. age 45 or older	.47	.03

The education variables also were highly correlated with the relative change in manufacturing employment in 1949, but not in 1959. Similarly, the education variables were highly correlated with proximity to SMSA's in 1949, but not in 1959. Clearly, the differences in the education distributions of rural farm adults among laborsheds in Minnesota lessened in the 10-year period. The result of these changes was that by 1959 the net effect of the age and education variables on rural farm income was erratic or insignificant.

The contribution of net migration in the previous 10 years could not be measured in 1949. In 1959, its contribution was blurred somewhat by the relationships between net migration and local urbanization (.74), average farm size (—.44), and the relative change in manufacturing employment (.31). Even so, the coefficient of the net migration variable was

larger than its standard error, and net migration was moderately correlated with rural farm income (.55). Net inmigration occurred in laborsheds that were relatively urbanized in 1960 and had high rural farm income levels. Net outmigration occurred in laborsheds that were relatively unurbanized and in laborsheds with small average farm size in 1960. Both of these types of laborsheds had low rural farm income levels in 1959. Inmigration contributed to the urbanization of laborsheds. Although outmigration may have contributed to rising rural farm income by drawing off excess labor supplies, the rise was not sufficient to eliminate the differential income levels between laborsheds experiencing net in- and outmigration.

The changing structure of industry and farm size structure were represented by the relative changes in manufacturing employment and average farm size, respectively. Positive coefficients on both variables were expected and obtained. The coefficients of average farm size were significantly different from zero in both years. Only in equation I was the coefficient of the relative change in manufacturing significant. However, the coefficients of this variable were larger than their standard errors in all equations, and in 1959 the coefficients verged on significance.

The matrices of simple correlations contain relevant information regarding these structural changes. First, relative changes in manufacturing employment were highly correlated with relative changes in employment in other industrial sectors in both periods. Those laborsheds that experienced rapid increases in manufacturing employment experienced rapid industrialization. Second, those laborsheds that experienced rapid employment gains in manufacturing were more urban and closer to SMSA's than other laborsheds. The result was a much higher simple correlation between rural farm income and changing industrial structure in 1959 than in 1949. But, all other factors being equal, the changing structure of industry was less important a determinant of rural farm income than farm size structure was in 1949 and 1959.

The availability of investment capital did not appear to be a factor influencing rural farm income in either 1949 or 1959. This conclusion must be tempered, however, by the fact that the measure used was inadequate.

Resource endowments were represented by crop value indexes. Mining endowments were represented by the zero-one mines variable. Since the value of standing timber was moderately correlated with the zero-one mines variables (.59), the value of timber was not introduced into the regression analysis.

The crop value index had an important impact on rural farm income in both years: The higher the crop value index was, the higher rural farm income was. The coefficient of the zero-one mines variable was not significantly different from zero in any of the rural farm equations. However, the signs of the coefficient were positive as hypothesized and the coefficients in the 1949 equations were larger than their standard errors. In 1949, therefore, natural endowments relative to mining and perhaps forestry probably contributed somewhat to rural farm income levels.

As discussed previously, there were two facets to the industrial-urban development hypothesis: the extent of local urbanization and the proximity to large industrial-urban complexes. Urban population in a laborshed as a percentage of total population represented local urbanization. Since the relative change in manufacturing employment was almost colinear with the population/distance variable, it was used as a proxy for both proximity and changing industrial structure.

Local urbanization did not appear to be important in explaining rural farm income levels in 1949. The simple correlation between percentage of urban population and rural farm income was low (.11), and the coefficient of the percentage urban variable, although positive, was not significantly different from zero. By 1959, the simple correlation coefficient between percentage urban and rural farm income increased to .46. Although the coefficient of the percentage urban variable was positive, it was not significant. However, the percentage urban and net migration variables were highly correlated (.74), enlarging the standard errors of the regression coefficients of both variables. Hence, the more extensive local urbanization was, the higher was rural farm income in 1959. Compared to the impact of farm size structure and agricultural resource endowments, however, local urbanization remained of minor importance.

The effect of *proximity to large industrial-urban complexes* was similar to that of local urbanization. Proximity appears to have had little effect on rural farm income in 1949. The simple correlations between rural farm income and population/distance and the relative change in manufacturing employment were very small in 1949: .03 and .02, respectively. What little effect proximity had on rural farm income in 1949 was positive.

By 1959 the simple correlations between rural farm income and population/distance and the relative change in manufacturing employment had risen to .31 and .17, respectively. The regression coefficient of the relative change in manufacturing was positive and verged on significance in the 1959 equations. Furthermore, net migration was moderately correlated with the relative change in manufacturing employment (.31), as was the percentage urban variable (.26). Hence, the net effect of proximity to large industrial-urban complexes probably was diffused among the coefficients of the percentage urban, the relative change in manufacturing employment, and the net migration variables. Even so, the net effect of proximity to SMSA's was of less importance in 1959 than factors associated with local agriculture.

In 1949, then, rural farm income in Minnesota laborsheds was determined largely by factors related to local agriculture (farm size and agricultural resource endowment), along with the age and education characteristics of the rural farm population. Resource endowments in minerals and forests probably affected rural farm income in only the five or six laborsheds in which mining and forestry were important. The changing structure of industry in Minnesota laborsheds, along with local urbanization and proximity to large industrial-urban complexes, played a minor role, if any at all.

By 1959, a number of important changes had occurred in the relationships. While farm size and agricultural resource endowments still played important roles in determining rural farm income, population characteristics ceased to be as important. The combined influences of local urbanization and proximity to large industrial-urban concentrations became more important. And net migration from rural to urban laborsheds between 1940 and 1950 was not sufficient to erase the positive relationships between rural farm income and local urbanization.

RURAL: RESULTS AND INTERPRETATION

The dependent variable for equations V and VI was the median income of rural families and unrelated individuals in 1959. The age and education variables encompass the rural population, and the two crop index variables represent different laborshed groupings than used for the 1959 rural farm equation. In equation V, the education variable is 0-6 years; in equation VI, it is 12 years and over.

Equation V accounted for 69 percent of tthe variance among laborsheds in rural income levels, whereas equation VI accounted for about 75 percent (see table 2).

Differences among laborsheds in the proportion of rural adults with little or no formal education had no effect on rural income. In contrast, the higher the proportion of rural adults with at least a high school education, the higher rural income was.

The proportion of rural persons age 45 and over was negatively correlated with net migration, with the proportion of the population that was urban, and with rural income levels: —.46, —.59, and —.44, respectively. In spite of these intercorrelations, the regression coefficient for the age variable was larger than its standard error in both equations and verged on significance in equation VI. Thus, the higher the proportion of rural people age 45 and over, the lower was rural income in a laborshed.

Net migration during the fifties reflects a host of forces that are difficult to untangle. Those laborsheds that experienced heavy net outmigration during the decade had a preponderance of elderly persons, were the least urbanized, had larger average farm size, and had a deficiency of persons with at least a high school education. These laborsheds also had lower rural income levels in 1959 than others. Net outmigration probably was one of the factors that allowed farm size to increase and so increased rural income. But net outmigration left behind an older and more poorly educated rural population. This consequence lowered rural income.

Those laborsheds that were relatively urban in 1950 attracted migrants during the fifties, making them more urban in 1960. The laborsheds that experienced heavy outmigration during the fifties had lower rural income levels in 1959 than those that experienced heavy inmigration. The negative effect of the changing age and education distributions in laborsheds experiencing heavy outmigration was greater than the positive impact of increasing farm size. In the absence of a system to separate these effects, the

most powerful influence reflected by the net migration variable probably was urbanization.

The coefficient of the capital availability variable was not significantly different from zero in either rural equation. Again, the results are inconclusive because of the inadequacy of the measure.

As noted before, the relative change in manufacturing employment during the fifties was closely related to relative changes in the entire industrial structure in Minnesota laborsheds. And the changing structure of employment by industry in a laborshed was closely related to the proximity of the laborshed to metropolitan areas. In brief, rapid increases in manufacturing employment were accompanied by rapid increases in transportation and in finance, insurance, real estate, and service employment, along with rapid declines in agriculture and wholesale and retail trade. Changes in mining and forestry employment were less related to changes in manufacturing employment. Furthermore, increases in manufacturing and transportation and in finance, insurance, real estate, and service employment took place more rapidly in laborsheds close to large industrial-urban complexes than in those farther removed. Similarly, declines in agricultural, forestry, and wholesale and retail trade employment took place more rapidly in laborsheds close to large industrial-urban concentrations.

The coefficient of the relative change in manufacturing employment variable was positive as expected and significantly different from zero. The more rapidly the structure of employment in a laborshed changed to an industrial structure during the fifties, the higher rural income was. Moreover, this change occurred most rapidly in laborsheds close to large metropolitan areas and most slowly in laborsheds far from them.

The coefficient of average farm size was positive as expected in both rural equations, significantly different from zero in one, and almost so in the other: The larger average farm size was, the higher was rural income. Compared with the urban and industrial structure variables used in this analysis, farm size structure did not appear to be of major importance in determining rural income. This relationship is in direct contrast to the relationships found in 1950 for the rural farm segment and somewhat in contrast to the relationships found in the 1960 rural farm component.

The crop index variables, which represented natural agricultural endowments, had positive coefficients in the rural equation. The higher the crop index was, the higher was rural income in a laborshed. These results indicate that the intensity of farm production and farm size are important determinants of rural income. However, agriculture is not predominant all over the state. In some areas, particularly in the north, crop indexes are low. In other areas, the joint effects of other variables overshadow the effects of agriculture.

The presence of large iron ore deposits did not appear to be important in determining rural income. The sign on the zero-one mining variable was erratic and the standard errors were much larger than the coefficients.

Location relative to urban centers and large industrial-urban concentrations appeared to be important in determining rural income in Minnesota

laborsheds. However, the evidence is indirect because of extensive intercorrelation. While the simple correlation between rural income and the percentage urban variable was positive (.51), the regression coefficient of the percentage urban variable was negative but not significant. Apparently, the close relationship between the relative urbanization of a laborshed in 1960 and net migration during the fifties (.74) allowed net migration to serve as an alternative measure of local urbanization, making the coefficient of the percentage urban variable statistically unreliable. The intercorrelation between the percentage urban and the percentage age 45 and over variables (—.59) also contributed to the unreliability of the percentage urban regression coefficient. Therefore, from the evidence of the results of the net migration variable, the more urban a laborshed was in 1960, the higher was its rural income.

The relative change in manufacturing employment variable also served as a proxy for the proximity of a laborshed to major metropolitan areas: The correlation between the relative change in manufacturing employment and the population/distance variables was .90 in 1960. The closer a laborshed was to a large metropolitan area, the more rapidly it industrialized during the sixties and the higher was its rural income level in 1960.

Industrialization does not occur randomly in Minnesota. It occurs most rapidly near existing metropolitan areas and least rapidly far from them. The existence of a large skilled labor force, the proximity of both privately and publicly supplied business services and low transportation and communications costs all combine to produce a positive relationship between industrialization and proximity to existing industrial-urban complexes. Urbanization and industrialization in Minnesota are occurring via the progressive expansion of existing centers into nearby areas. The Minnesota laborsheds located some distance from the cities of Twin Cities, Fargo-Moorhead, Rochester, Mankato, St. Cloud, and Duluth-Superior are slowly becoming more urbanized and industrialized.

In summary, urbanization, industrialization, and proximity to large metropolitan areas were important factors accounting for inter-laborshed differences in rural income levels in 1959. The presence of natural agricultural resource endowments and a preponderance of rural adults who had at least completed high school also were important. A preponderance of elderly rural persons and small farms measured in terms of acres were of less importance. Inadequate measures of local capital availability and other natural resource endowments prohibited a clear judgment of the importance of these factors. Urbanization and industrialization appear to have spread out from the existing metropolitan areas, principally the Twin Cities, since 1940, rather than to have occurred randomly or evenly throughout the state.

CONCLUSIONS

The evidence derived from this analysis shows clearly that agriculture remains an important industry in determining rural and rural farm income

in Minnesota laborsheds. However, agriculture appears to be declining slowly in importance as local laborsheds become urbanized and industrialized.

Mining also appears to be declining in importance as a determinant of rural farm income in the few laborsheds possessing important mineral deposits. This conclusion may be strictly statistical, since it is possible that few miners defined as rural farm residents in 1950 were so defined in 1960. In any case, other factors overshadowed mining as determinants of rural farm and rural income in 1960.

Local urbanization, the changing structure of industry, and the proximity to metropolitan areas, all facets of industrial-urban development, are becoming important determinants of rural and rural farm income. This industrial-urban growth does not occur randomly or evenly, but proceeds in everwidening circles from existing concentrations.

Industrial decentralization holds little promise for rural areas beyond the expanding circle of an existing industrial-urban concentration. If the goal of "remote" rural areas is to experience industrial-urban growth, this growth must be induced. Furthermore, if the locational aspects of industrial-urban growth revealed in this study are pervasive, the growth center strategy of development is appropriate: Attempt to concentrate increases in industry, public facilities and services, and population in one center or potential center in the area. At some level, industrial-urban growth will continue unaided and spread outward from that center into rural areas.

APPENDIX

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SPECIFICATION OF VARIABLES

Y_1 = median income of rural farm families and unrelated individuals per laborshed in 1949 (18)
Y_2 = median income of rural farm families and unrelated individuals per laborshed in 1959 (19)
Y_3 = median income of rural families and unrelated individuals per laborshed in 1959 (19)
X_1 = bank loans and discounts/bank deposits per laborshed in 1949 (1959) (Federal Reserve Bank of Minneapolis)
X_2 = population/distance variable per laborshed in 1950 (1960)
X_3 = net migration per laborshed from 1950 to 1960 (10)
X_4 = urban population as a percentage of total population per laborshed in 1950 (1960) (18, 19)
X_5 = average farm size per laborshed in 1950 (1960) (8)
X_6 = rural farm (rural) population less than 25 years old as a percentage of total rural farm (rural) population in 1950 (1960) (18, 19)
X_7 = rural farm (rural) population 45 years old and older as a percentage of total rural farm (rural) population per laborshed in 1950 (1960) (18, 19)
X_8 = forestry value index per laborshed in 1950 (1950)
X_9 = rural farm (rural) population age 25 and over who had completed 0-6 years of school as a percentage of total rural farm (rural) population age 25 and over per laborshed in 1950 (1960) (18, 19)
X_{10} = rural farm (rural) population age 25 and over who had completed at least 12 years of school as a percentage of total rural farm (rural) population age 25 and over per laborshed in 1950 (1960) (18, 19)
X_{11} = crop value index per laborshed in 1950 (1960)
X_{Ii} = crop value index of laborshed i if i = Clay-Cass, Carlton, Polk-Grand Forks, St. Louis, Red Lake, Itasca, Koochiching, Crow Wing, or Mille Lacs laborsheds
= 0, otherwise
X_{IIi} = crop value index of laborshed i if $X_{Ii} = 0$
= 0, if $X_{Ii} > 0$
X_{IIIi} = crop value index in laborshed i if i = Clay-Cass, Carlton, Polk-Grand Forks, St. Louis, Itasca, Koochiching, Crow Wing, Benton-Sherburne-Stearns, Cook, or Lake laborsheds
= 0, otherwise
X_{IVi} = crop value index in laborshed i if $X_{IIIi} = 0$
= 0, if $X_{IIIi} > 0$

X_{12} = unemployment rate per laborshed in 1950 (1960)
X_{13} = 1 if laborshed contains a city classified as a complete shopping center or greater
= 0, otherwise
X_{14} = 1 if laborshed contains a significant iron ore deposit
= 0, otherwise
X_{15} = relative change in agricultural employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{16} = relative change in forestry and fishery employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{17} = relative change in mining employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{18} = relative change in manufacturing employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{19} = relative change in transportation and communications employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{20} = relative change in wholesale and retail trade employment per laborshed from 1940 to 1950 (from 1950 to 1960) (20)
X_{21} = relative change in employment in finance, insurance, real estate, and services per laborshed from 1940 to 1950 (from 1950 to 1960) (20)

Table A-1. Simple correlation matrix, rural farm, 1949

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
X_1	1.00	.06	–	-.10	-.11	-.12	.20	.10	.03	.04	.05	.16	-.16	-.05	-.04	.02	0	.04	.05	.02	-.06
X_2	–	1.0	–	.39	.19	-.15	.23	.09	.73	.88	.02	.07	.15	.07	-.76	.52	.18	.99	.98	.90	-.91
X_3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
X_4	–	–	–	1.0	-.34	-.05	.03	.18	.22	.29	.11	.09	.65	.14	-.18	.34	.29	.38	.40	.30	-.40
X_5	–	–	–	–	1.0	.23	-.37	-.30	-.22	-.02	-.28	-.22	-.22	-.24	.04	-.29	-.21	-.20	-.15	-.10	.20
X_6	–	–	–	–	–	1.0	-.67	-.21	-.19	-.07	.10	-.25	-.13	-.46	.31	-.21	-.22	-.13	-.15	-.05	.21
X_7	–	–	–	–	–	–	1.0	.43	.38	.07	-.32	.51	.08	.28	-.28	.32	.29	.22	.24	.11	-.30
X_8	–	–	–	–	–	–	–	1.0	.29	-.10	-.39	.84	.14	.59	-.03	.54	.80	.06	.16	-.20	-.33
X_9	–	–	–	–	–	–	–	–	1.0	.46	-.37	.32	.17	.13	-.43	.41	.27	.74	.77	.61	-.73
X_{10}	–	–	–	–	–	–	–	–	–	1.0	.20	-.06	.09	-.05	-.73	.39	-.04	.89	.85	.89	-.76
X_{11}	–	–	–	–	–	–	–	–	–	–	1.0	-.44	.09	-.16	-.10	-.12	-.27	.03	-.03	.15	.09
X_{12}	–	–	–	–	–	–	–	–	–	–	–	1.0	.06	.57	-.04	.41	.61	.04	.13	-.14	-.24
X_{13}	–	–	–	–	–	–	–	–	–	–	–	–	1.0	.11	-.13	.30	.15	.16	.20	.19	-.18
X_{14}	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	-.04	.40	.62	.04	.12	-.11	-.22
X_{15}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	-.40	-.06	-.75	-.73	-.74	.69
X_{16}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	.60	.50	.55	.32	-.65
X_{17}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	.13	.25	-.19	-.48
X_{18}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	.98	.91	-.90
X_{19}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	.87	-.93
X_{20}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0	-.71
X_{21}	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.0
Y_1	10	.03	–	.11	.17	.24	-.57	-.33	-.39	.26	.64	-.39	.01	-.11	-.05	-.01	-.09	.02	-.00	.08	.02

Table A-2. Simple correlation matrix, rural farm, 1959

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
X_1	1.0	.09	.37	.23	-.00	.19	-.35	-.24	-.38	.33	.36	-.36	.03	-.08	-.09	.01	.02	.10	.04	-.04	.12
X_2	—	1.0	.37	.39	-.17	.04	.02	.07	-.02	.03	.11	.01	.15	.05	-.85	-.50	-.13	.90	.83	-.95	.97
X_3	—	—	1.0	.74	-.44	.17	-.13	.09	-.26	.20	.44	-.20	.59	.18	-.49	-.19	-.25	.31	.17	-.35	.40
X_4	—	—	—	1.0	-.16	.29	-.15	.11	-.21	.16	.28	-.16	.73	.10	-.44	-.25	-.19	.26	.14	-.41	.40
X_5	—	—	—	—	1.0	.02	-.07	-.21	.12	-.00	-.30	.03	-.24	-.20	.20	-.03	.19	-.14	.10	.18	-.11
X_6	—	—	—	—	—	1.0	-.77	-.28	-.29	.10	.08	-.35	.21	-.21	-.04	-.22	.11	.10	.08	-.00	.08
X_7	—	—	—	—	—	—	1.0	.38	.48	-.25	-.11	.46	-.06	.29	-.04	.14	-.21	-.09	-.07	-.10	-.02
X_8	—	—	—	—	—	—	—	1.0	.38	-.12	-.33	.58	.14	.59	-.13	.18	-.68	-.20	-.31	-.24	-.04
X_9	—	—	—	—	—	—	—	—	1.0	-.58	-.38	.52	-.06	.13	.00	.09	-.24	-.10	-.13	-.03	-.04
X_{10}	—	—	—	—	—	—	—	—	—	1.0	.35	-.34	-.09	.01	.07	-.06	.10	-.01	.01	-.04	.01
X_{11}	—	—	—	—	—	—	—	—	—	—	1.0	-.41	.17	-.14	-.16	-.20	.26	.18	.19	-.03	.14
X_{12}	—	—	—	—	—	—	—	—	—	—	—	1.0	-.00	.52	.01	.34	-.48	-.08	-.10	-.08	-.04
X_{13}	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.11	-.31	-.15	-.22	.10	.01	-.17	.18
X_{14}	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.03	.36	-.77	-.13	-.22	-.15	-.03
X_{15}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.50	.15	-.80	-.68	.80	-.88
X_{16}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.28	-.46	-.45	.47	-.51
X_{17}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.07	.22	.22	-.06
X_{18}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.96	-.77	.95
X_{19}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.68	.88
X_{20}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.89
X_{21}	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0
Y_2	.19	.31	.55	.46	.05	-.01	.03	.22	.14	.13	.28	.07	.32	.23	-.34	-.20	-.27	.17	.09	-.32	.33

Table A-3. Simple correlation matrix of rural farm regression equations, 1959

	X_1	X_4	X_5	X_7	X_9	X_{10}	X_1	X_{11}	X_{14}	X_{18}	X_3
X_1	1.0	.23	-.00	-.35	-.38	.33	-.14	.32	-.08	.10	.37
X_4	—	1.0	-.16	-.15	-.21	.16	.16	.10	.10	.26	.74
X_5	—	—	1.0	-.07	.12	-.00	.13	-.28	-.20	-.14	-.44
X_7	—	—	—	1.0	.48	-.25	.16	-.17	.29	-.09	-.13
X_9	—	—	—	—	1.0	-.58	.34	-.44	.13	-.10	-.26
X_{10}	—	—	—	—	—	1.0	.13	.31	.01	-.01	.20
X_1	—	—	—	—	—	—	1.0	0.0	.39	-.10	.24
X_{11}	—	—	—	—	—	—	—	1.0	-.31	.18	.17
X_{14}	—	—	—	—	—	—	—	—	1.0	-.13	.18
X_{18}	—	—	—	—	—	—	—	—	—	1.0	.31
X_3	—	—	—	—	—	—	—	—	—	—	1.0
Y_2	.19	.46	.05	.03	.14	.13	.60	-.14	.23	.17	.55

Table A-4. Simple correlation matrix, rural, 1959

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
X_1...	1.0	.04	.37	.23	-.00	.11	-.24	-.24	-.17	.36	.36	-.36	.03	-.08	-.09	.01	.02	.10	.04	-.04	.12
X_2...	—	1.0	.37	.39	-.17	.12	-.19	.07	-.02	.15	.11	.01	.15	.05	-.85	-.50	-.13	.90	.83	-.95	.97
X_3...	—	—	1.0	.74	-.44	.30	-.46	.09	-.16	.38	.44	-.20	.59	.18	-.49	-.19	-.25	.31	.17	-.35	.40
X_4...	—	—	—	1.0	-.16	.48	-.59	.11	-.04	.14	.28	-.16	.73	.10	-.44	-.25	-.19	.26	.14	-.41	.40
X_5...	—	—	—	—	1.0	-.10	.12	-.21	.02	-.13	-.30	.03	-.24	-.20	.20	-.03	.19	-.14	.10	.18	-.11
X_6...	—	—	—	—	—	1.0	-.89	.21	-.06	-.05	-.01	-.01	.37	-.02	-.12	-.11	-.01	.12	-.04	-.11	.16
X_7...	—	—	—	—	—	—	1.0	-.12	.06	-.03	-.19	.21	-.40	-.01	.19	.04	-.05	-.16	.07	.18	-.22
X_8...	—	—	—	—	—	—	—	1.0	.03	.08	-.33	.58	.14	.59	-.03	.18	-.68	-.20	-.31	-.24	-.04
X_9...	—	—	—	—	—	—	—	—	1.0	-.20	-.07	.01	.08	.01	.03	.08	.05	-.03	-.03	-.01	-.04
X_{10}..	—	—	—	—	—	—	—	—	—	1.0	.17	.06	-.12	.12	-.04	-.35	.06	.09	.08	-.14	.15
X_{11}..	—	—	—	—	—	—	—	—	—	—	1.0	-.41	.17	-.14	-.16	-.20	.26	.18	.19	-.03	.14
X_{12}..	—	—	—	—	—	—	—	—	—	—	—	1.0	-.00	.52	.01	.34	-.48	-.08	-.10	-.08	-.04
X_{13}..	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.11	-.31	-.15	-.22	.10	.01	-.17	.18
X_{14}..	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.03	.36	-.77	-.13	-.22	-.15	-.03
X_{15}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.50	.15	-.80	-.68	.80	-.88
X_{16}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.28	-.46	-.45	.47	-.51
X_{17}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.07	.22	.22	-.06
X_{18}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	.96	-.77	-.95
X_{19}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.68	.88
X_{20}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0	-.89
X_{21}..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.0
Y_3...	.22	.36	.69	.51	-.12	.33	-.44	.26	-.12	.49	.27	.07	.34	.14	-.38	-.42	.03	.27	.17	-.34	.40

Table A-5. Simple correlation matrix of rural regression equations, 1959

	X_1	X_4	X_5	X_7	X_9	X_{10}	X_{III}	X_{IV}	X_{14}	X_{18}	X_3
X_1	1.00	.23	-.00	-.24	-.17	.36	.28	.00	-.08	.10	.37
X_4	–	1.00	-.16	-.59	-.04	.14	.27	.04	.10	.26	.74
X_5	–	–	1.00	.12	.02	-.13	.11	-.23	-.20	-.14	-.44
X_7	–	–	–	1.00	.06	-.03	-.21	-.02	-.01	-.16	-.46
X_9	–	–	–	–	1.00	-.20	.02	-.06	.01	-.03	-.16
X_{10}	–	–	–	–	–	1.00	.05	.09	.12	.09	.38
X_{III}	–	–	–	–	–	–	1.00	0.00	.40	-.07	.25
X_{IV}	–	–	–	–	–	–	–	1.00	-.32	.17	.01
X_{14}	–	–	–	–	–	–	–	–	1.00	-.13	.18
X_{18}	–	–	–	–	–	–	–	–	–	1.00	.31
X_3	–	–	–	–	–	–	–	–	–	–	1.00
Y_3	.22	.51	-.12	-.44	-.12	.49	.47	-.07	.14	.27	.69